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Lateral Load Analysis of High-Rise RC Framed Building with and without RC Shear Walls

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Abstract: Shear wall are used in tall buildings as supporting element to resist earthquake loading. The RC shear wall is the most reliable method of construction of shear wall which makes the structure resistant against lateral forces. Shear wall systems are one of the most commonly used lateral load resisting systems in high rise buildings.
A study on an high rise building with shear wall and without shear wall at different locations was studied to understand the lateral loads and shear effects.in this paper six models are analysed with and without shear wall at different location, one at the corners, one at the periphery and center core of the building through ETABS software. Estimation of structural response such as; base shear, storey displacement, storey acceleration and storey drift is carried out. In equivalent static load method and response spectrum method is used.
Keywords: Shear wall, equivalent static method, response spectrum method, storey drift, storey displacement.

I. INTRODUCTION

Reinforced concrete buildings often have vertical plane like (RC) walls called Shear Walls. They could be placed symmetrically along one or both directions in plan. Shear walls, are more effective when located along exterior perimeter of the building such a layout increases resistance of the building to twisting. The purpose of all kinds of structural systems used in the building types of structures is to transfer gravity loads effectively. The most common loads resulting from the effect of gravity are dead load, live load and snow load. Besides these vertical loads, buildings are also subjected to the lateral loads caused by wind, blasting or earthquake.

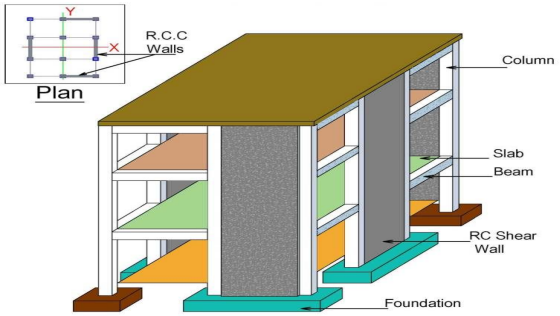
Lateral loads can develop high stresses, produce sway movement or cause vibration. Therefore, it is very important for the structures to have sufficient strength against vertical loads together with the adequate stiffness to resist lateral loads. The shear wall structures have been recognized as one of the most efficient structural system for such a purpose. The main objective of this project is to analyze the given high rise building using equivalent static method for software validation and response spectrum method for analysis of the given building with and without shear wall. Then check and compare the seismic response of high rise building with and without shear wall & for different location of shear wall, so that one can choose the best alternative for construction in earthquake-prone area.

A. Definition and Function of Shear Wall

1) *Definition:* Shear wall is a structural member in a reinforced concrete framed structure to resist the lateral forces such as wind forces. Shear walls are vertical elements of the horizontal force resisting system. shear walls are generally used in high rise buildings subjected to lateral wind and seismic forces. Generally, shear walls are either plane or flanged in section while core walls consists of channel section. They also provide adequate strength and stiffness to control lateral displacements.
2) *Function of shear wall:* Rc shear walls provide large strength and stiffness to buildings in the direction of their orientation,which significantly reduces lateral sway of the building and thereby reduces damage to structure and its contents. Since shear walls carry large horizontal earthquake forces, the overturning effects on them are large. Shear wall in buildings must be symmetrically located in plan to reduce ill-effects of twist in buildings. They could be placed symmetrically along one or both directions in plan. Shear walls are more effective when located along exterior perimeter of the building such a layout increases resistance of the building to twisting.

It consists of reinforced concrete walls and reinforced concrete slabs. Wall thickness varies from 150 mm to 400 mm, depending on the number of stories, building age, and thermal insulation requirements. In general, these walls are continuous throughout the building height; however, some walls are d spaces. Usually the wall layout is symmetrical with respect to at least one axis of

symmetry in the plan. Structural modification are not very common in this type of construction. Reinforcement requirements are based on building code requirements specific for each country. In general, the wall reinforcement consists of two layers of distributed reinforcement (horizontal and vertical) throughout the wall length.



Reinforced Concrete Shear Wall

II. OBJECTIVES

A. To study the earthquake response of RC frame buildings with different types of shearwalls and location of shear wall arrangement building by seismic analysis.
B. To analyze the structure with RC frame building with different types and shear wall locations effect for wind Analysis.
C. To study the lateral loads response of RC bare frame building by seismic analysis and wind analysis.
D. To compare the lateral loads response of model-1, model-2, model-3, model-4, model-5 and model-6.

III.METHODOLOGY

A multi-storied buildings are considered, 30 storey (G+29) building consists of 5 bays of 7.5m along X axis and 5 bays of 7.5m along Y axis.

The following models have been considered in the present work

1) *Model I:* RC bare frame (BF).
2) *Model II:* RC frame with U-shaped Shearwalls at periphery.
3) *Model III:* RC frame with L-shaped Shearwalls at corners.
4) *Model IV:* RC frame with rectangle-shaped Shearwalls at periphery.
5) *Model V:* RC frame with core-shaped Shearwalls at center.
6) *Model VI:* RC frame with core-rectangle-L-shaped Shearwalls at center-periphery-corners.

The following is the building data assumed for the analysis. Loads are taken according to IS 875(I & II) and analysis is done according to IS 1893.

Table. 1

Material:	
Concrete	f_{ck} 40
Steel Reinforcement	Fe500
Dimensions	
Slab	150mm
Wall	300mm
Beam	300X750mm
Column	900 X 900mm
Loads	
Live Load	4 kn/m^2
Floor load	1 kn/m^2
Wall load	16.1kn/m
Seismic consideration	
Zones factors	0.10, 0.16, 0.24 and 0.36
Soil type	II
Response Reduction factor	5
Importance factor	1

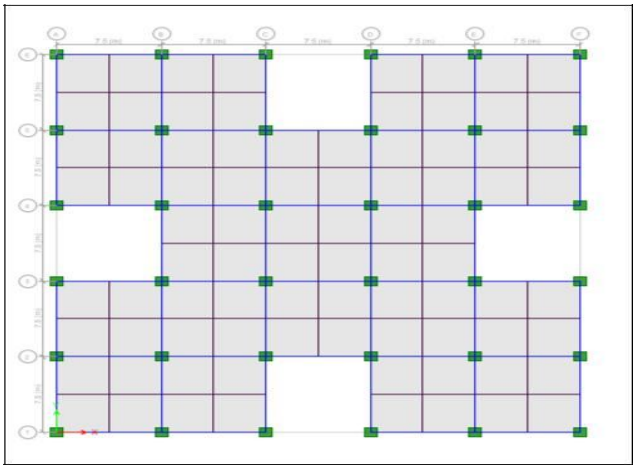


Fig.3.1 Plan of the building

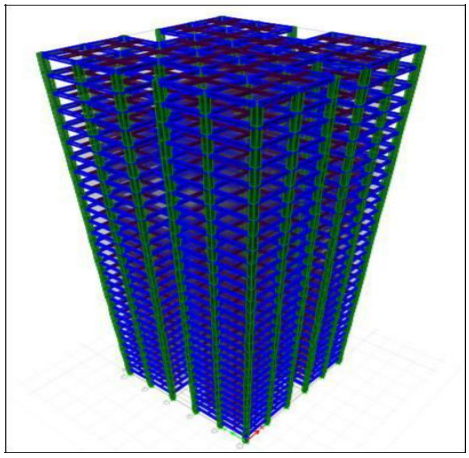


Fig.3.2. 3D model of the building

IV. RESULTS AND DISCUSSION

This research work is carried out to compare the lateral load response of all models. Totally six models are considered for the lateral load analysis which includes seismic analysis (equivalent static and response spectrum analysis).

A. Storey Displacement

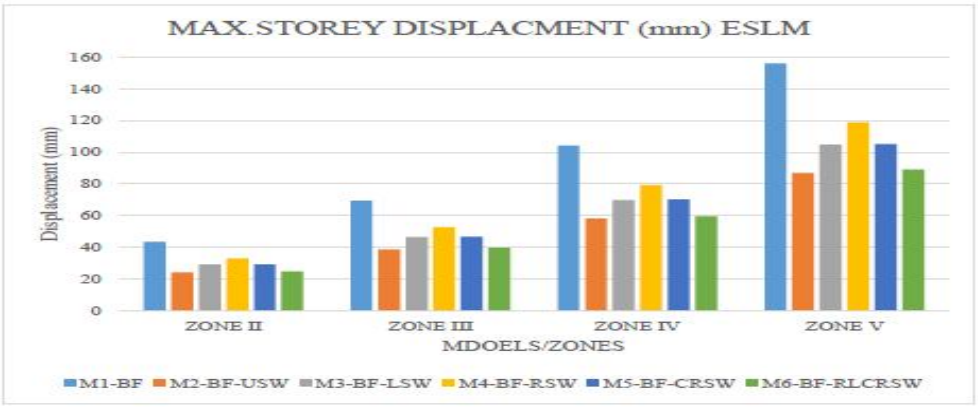


Fig 4.1 Comparison of Max. Storey Displacements for all models along X & Y axis for all Zones by ESLM analysis

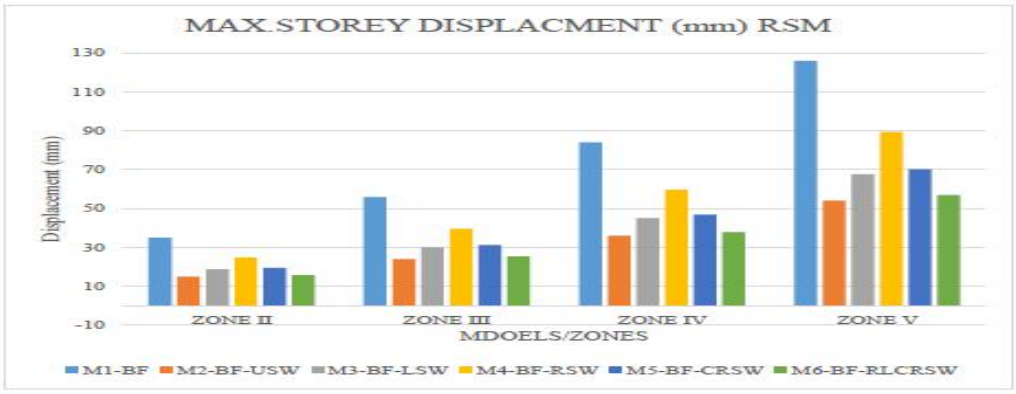


Fig 4.2 Comparison of Max. Storey Displacements for all models along X & Y axis for all Zones by RSM analysis

From Fig 4.1 and Fig 4.2 it is clear that displacement increases with increase in zone factors hence zone V is having higher displacements and zone II is having less displacements for all models.

B. Storey Drift

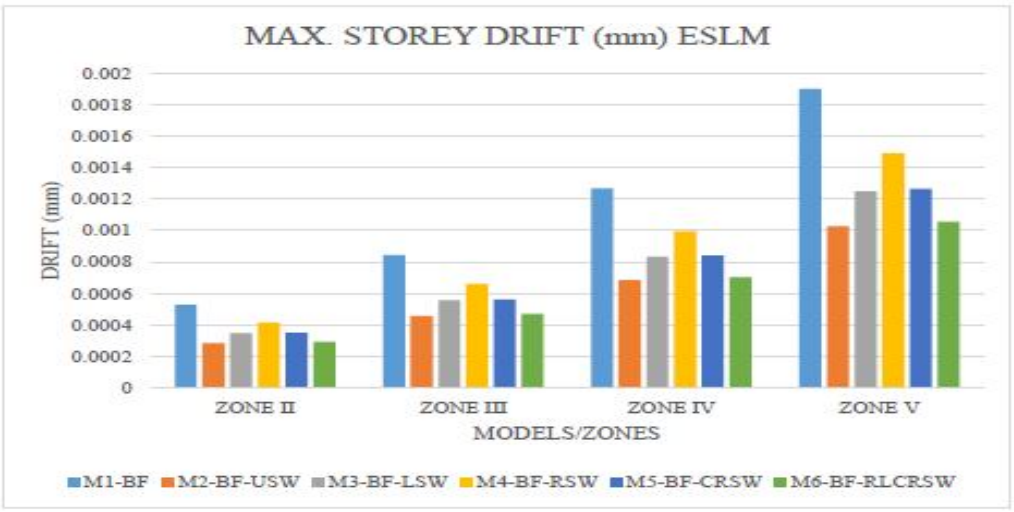


Fig 4.3 Comparison of Max. Storey Drift for all models along X & Y axis for all Zones By ESLM analysis

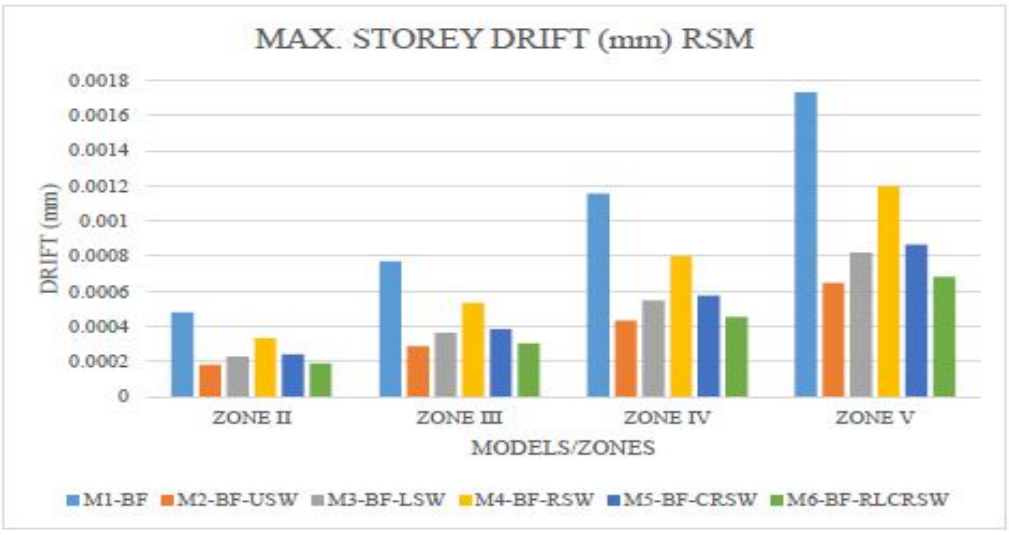


Fig 4.4 Comparison of Max. Storey Drift for all models along X & Y axis for all Zones By RSM analysis

From the fig 4.3 and fig 4.4 obtained storey drift values of all different models are within the limit. And it is clear that the storey drift can be reduced by providing RC frame with shearwalls.

V. CONCLUSION

The results obtained from analysis are investigated and compared. From comparison of results following are the major conclusions drawn.

A. There is an increasing order in the values of storey displacement, storey drift for Zone II, Zone III, Zone IV and Zone V in X and Y directions for all Combinations of models.

B. As per analysis, it is concluded that storey displacement at different level in multistoried building with shear wall is comparatively lesser as compared to R.C.C. building Without Shear Wall.

C. It is observed that the providing shear walls is economical and effective in high rise buildings. Providing shear walls at adequate locations substantially reduces the displacements due to earthquake and wind.

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